Natural Gas: Past, Present & Interesting Future

Southern California Energy Conference
Los Angeles, CA
10th March 2006

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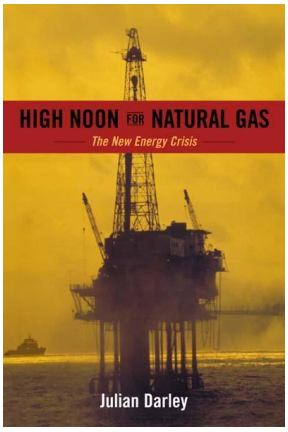
http://www.postcarbon.org

Why write a book about natural gas?



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Brief history of natural gas use in US

- 1821 first gas well, in Fredonia, NY - 27ft deep
- Early industrial US - street lamps & a few houses
- Pipelines networks in 1930s & 1950s – demand increases
- Last 25 years - much more deregulation
- 1990 EPA Clean Air Act Amendment
  - more gas, less coal – gas is the 'cleanest' hydrocarbon

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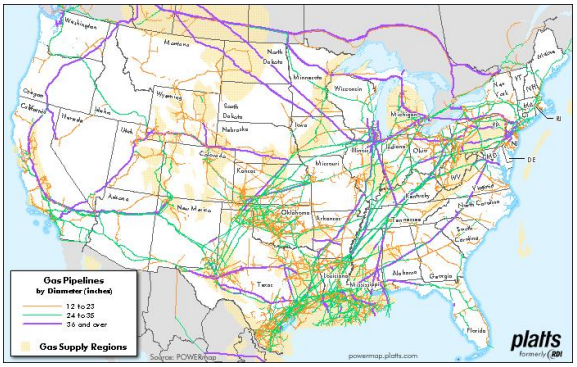
US natural gas pipelines

- Natural gas service is delivered to over 60 million American homes through a 1.3-million-mile pipeline network. (http://www.atmosenergy.com/about/gas/index.html)
- Gas is hard to transport – means it is a regional fuel



http://www.platts.com/features/usgasguide/pipelinemap.shtml

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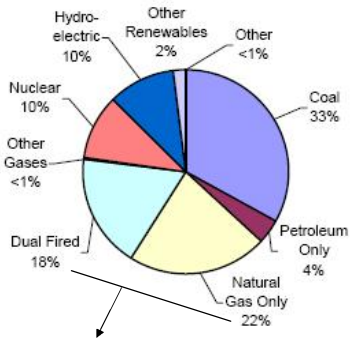
America's Gas Dependence

- ~23% of primary energy
- ~60% American homes heat with gas
  - 70% of new homes (80% in Canada)
- Power generation gas-fired - capacity ~40%
  - Actual power delivered by gas 17-18%
  - >220,000 Mw gas-fired capacity added in last 6 years
  - Hydro in trouble – global warming?
  - Kyoto – trouble for all fossil fuels, especially coal?

U.S. Net Power Generation by Energy Source vs capacity (2003)

Capacity



Natural gas capacity up to 40%

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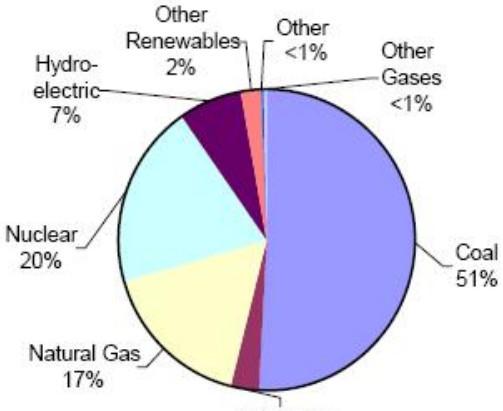
Generation



http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html

Why did demand increase so much?
Natural gas is so useful…

- Very versatile fuel, especially for heating – domestic and industry
- For power production can produce baseload and peaking – very controllable
- 80% of fertilizer price is natural gas
  - 45% of nitrogen fertilizer makers have shut down
- NG is feedstock for many other chemical processes
- Natural gas now used everywhere
- Conclusion: NG is vital – it's a matter of national security – must have more

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How much more?

Energy Hunger

- US Gas Consumption
  - Natural Gas ~ 50 - 60 billion cubic feet per day (~22 Tcf/yr)
    - US imports 15-17%
      - Most from Canada + 2% LNG
  - Oil >21 million barrels per day (7bnb/yr)
    - US imports ~60%, rising to 70-80% by 2025?
- World consumption
  - Oil ~84 mb/d (~31 bnb/yr)
  - Natural gas ~ 200 bcf/d (~80 Tcf/yr)

But suddenly..

- Natural gas was in the limelight (for a while)
- "We start from the premise that we are in a natural-gas crisis."
  Mark Nelson, American Chemistry Council (May 28, 2003)
- "The game's over for U.S. gas supply, same with Canadian."
  Marshall Adkins, Raymond James & Associates (April 29, 2003)
- "The natural gas crunch is so serious that it might complicate President Bush's 2004 re-election."
  Laura Cohn, Business Week (June 16, 2003)

Official concern

- Alan Greenspan testifies before Congress
  - “We are not apt to return to earlier periods of relative abundance and low prices anytime soon.”
    House Energy and Commerce Committee (June 10th 2003)
  - "I'm quite surprised at how little attention the natural gas problem has been getting,because it is a very serious problem.”
    (May 21, 2003)
- (former) Energy Secretary Spencer Abraham calls for emergency Natural Gas Summit at National Petroleum Council (June 26th 2003)
  - to discuss short-term solutions. "A hot summer could increase demand for natural gas and exacerbate the problem," Abraham says. "The challenge requires us to act today."

A Crisis Loomed

- Demand for natural gas rose to 22.6 Tcf (trillion cubic feet) in 2001
- But domestic supply couldn't keep up
  - 19.5Tcf in 2001
- Supply gap was over 3 Tcf & rising (or trying to)
- Expensive & difficult to import by sea – needs long lead time to increase facilities
- In early new millennium gas supply suddenly began to fall

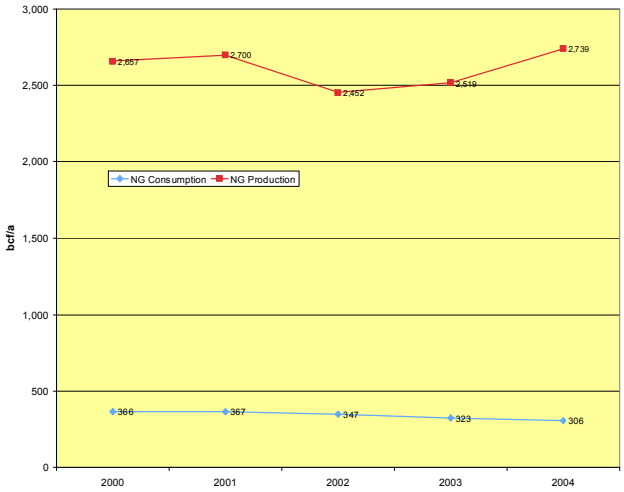
So What Happened To The Natural Gas Crisis?

- Much higher prices
  - Leading to industrial 'demand destruction'
  - Power generators went broke
- Weather
  - Mild winters
  - Mild summers
- The rise of unconventional gas

Has The Natural Gas Crisis Gone Away?

- EIA shows some concern but tries to appear confident that new technology and investment will solve the problem – but some of their own graphs suggest that they are not that sure
- Energy banker Matt Simmons shows great concern and much less confidence in the offered solutions
- Who to believe?

California Natural Gas Consumption & Production



from EIA data

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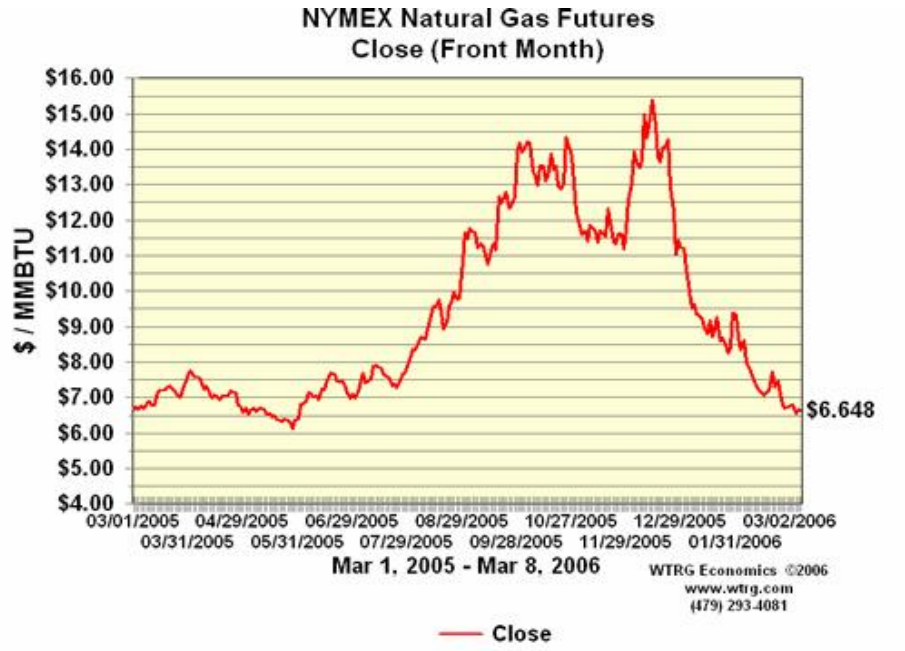

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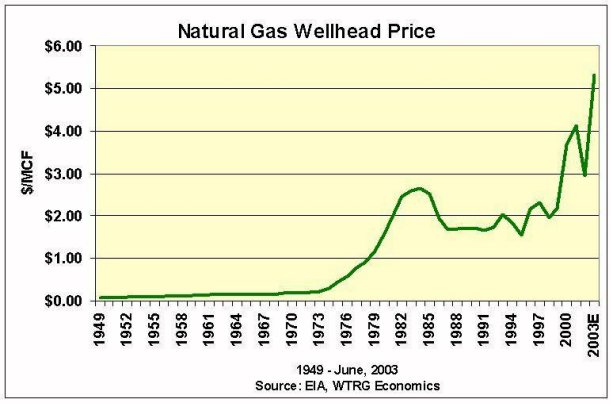
Gas used to be much cheaper

- 1 boe ~ 5.5 Mcf
  - with oil over $15 bbl, gas was good value at ~$2 Mcf



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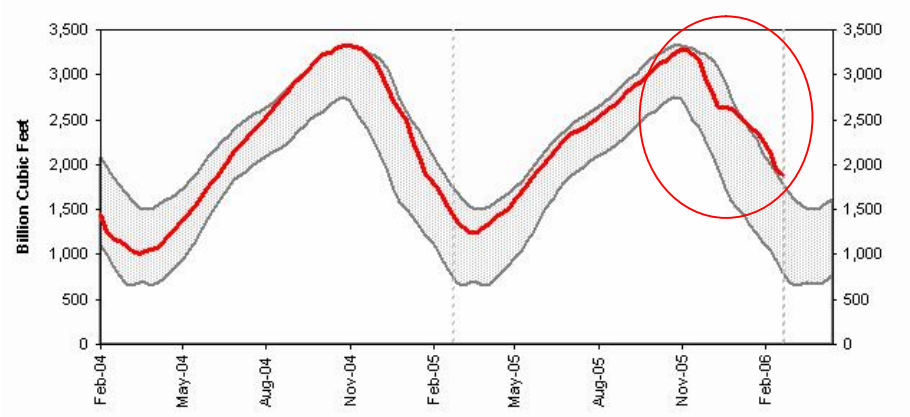
Working Gas in Underground Storage Compared with 5-Year Range



http://tonto.eia.doe.gov/oog/info/ngs/ngs.html

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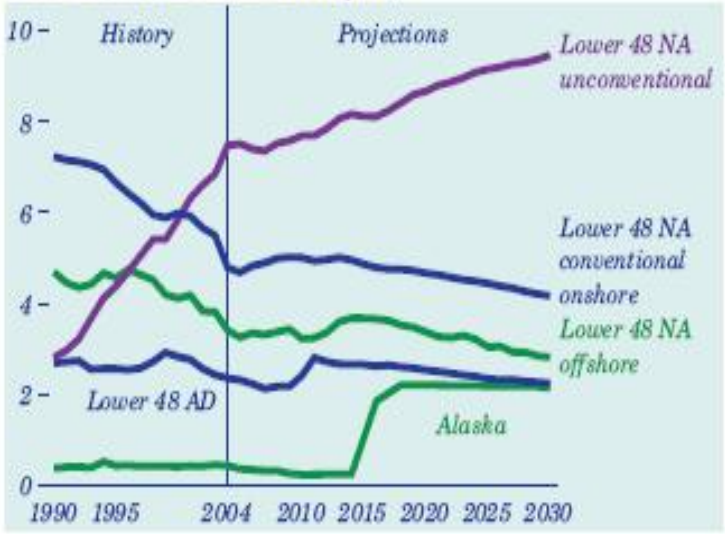
Figure 73. Natural gas production by source, 1990-2030 (trillion cubic feet)

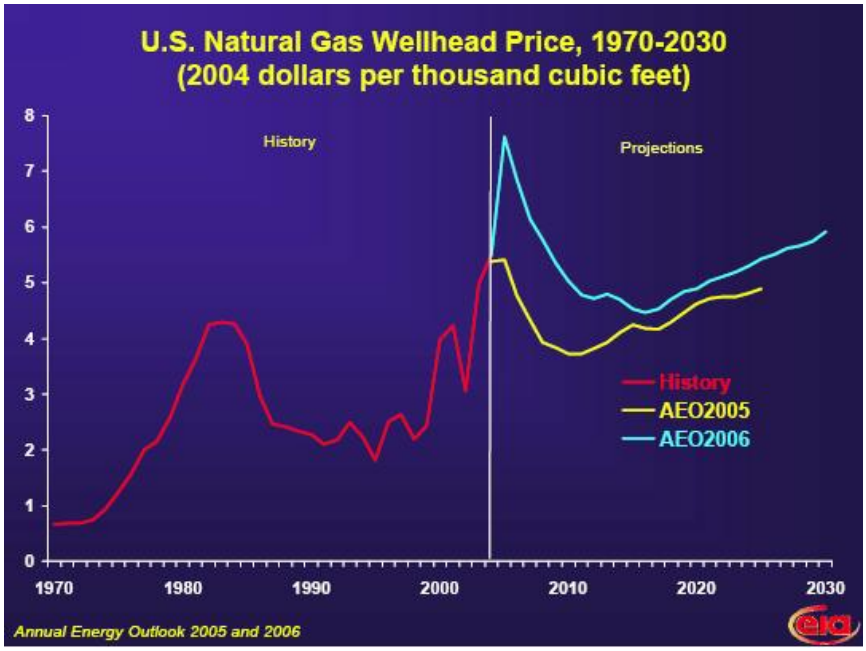


Energy Information Administration Annual Energy Outlook 2006, p. 86

EIA Has Reassessed Its Long-Term Oil Price Projection

- Major oil-producing countries pace investment more consistent with higher oil price path
- Investment impediments more persistent, even after several years of relatively high oil prices
- Cost of doing business increasing
- Not due to "Peak Oil" considerations, although we are following this issue closely

Guy Caruso, Administrator
Energy Information Administration, U.S. Department of Energy
http://www.ncseonline.org/NCSEconference/2006conference/cms.cfm?id=832



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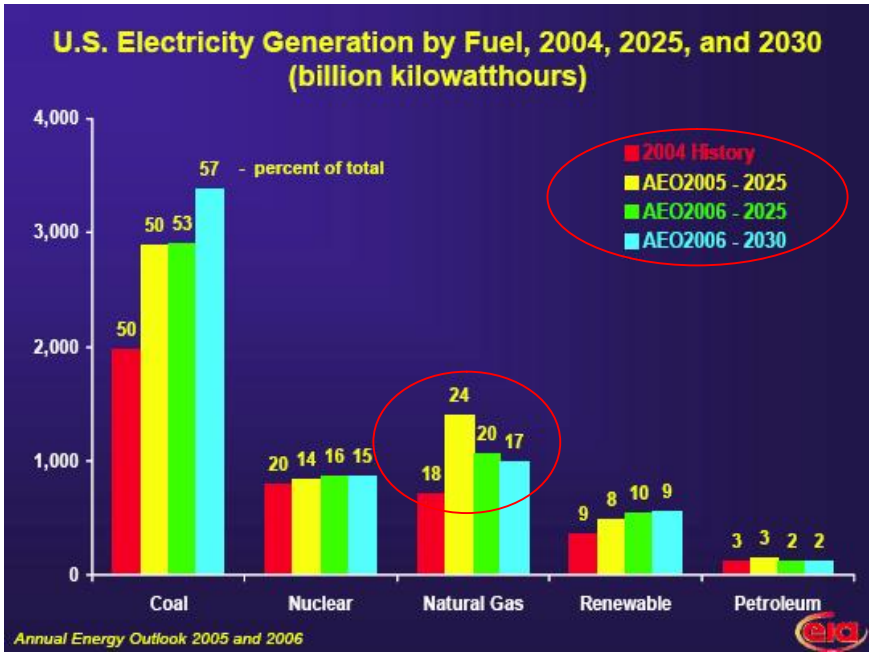

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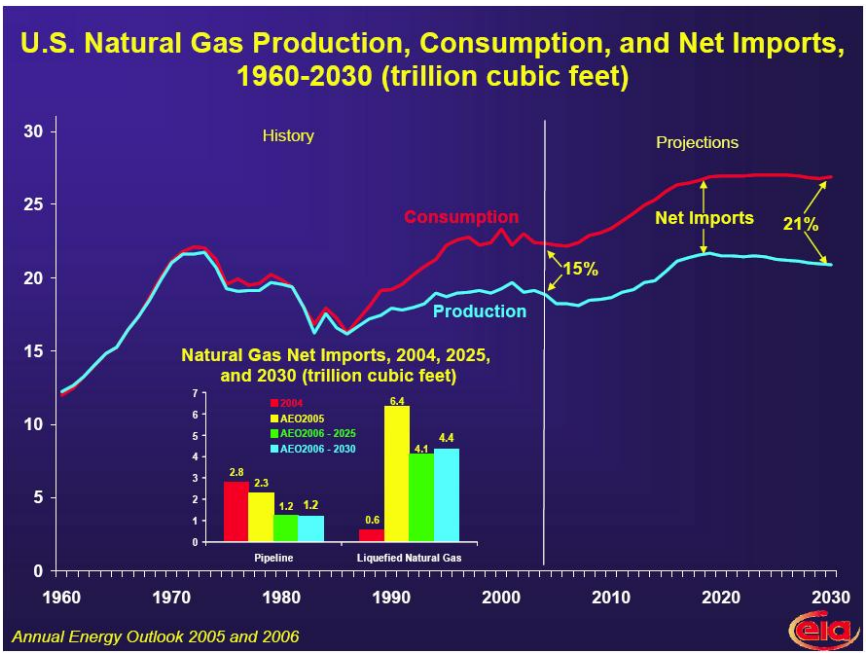
Annual Energy Outlook 2006 reference case indicates that through 2030....

- U.S. energy demand is projected to grow at an average annual rate of 1.1 percent
- The energy efficiency of the economy is projected to increase at an average annual rate of 1.8 percent
- U.S. oil import reliance is projected to grow from 58 percent to 62 percent
- U.S. natural gas use is projected to peak around 2020
- Future growth in U.S. natural gas supplies depends on unconventional domestic production, natural gas from Alaska, and liquefied natural gas imports
- Carbon dioxide emissions are projected to grow at an average annual rate of 1.2 percent



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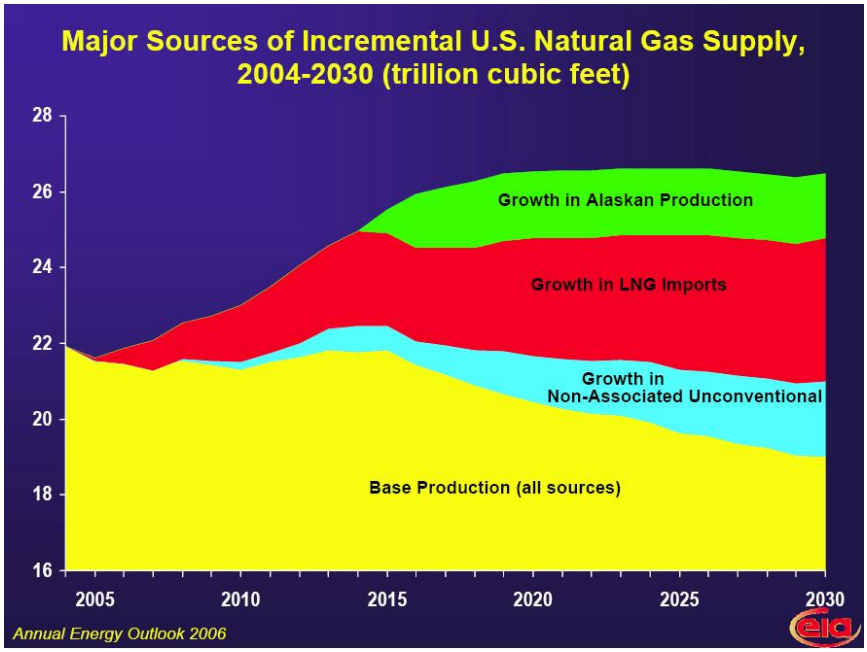

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Periodic Reports

Petroleum Status and Natural Gas Storage Reports, weekly

Short-Term Energy Outlook, monthly

Annual Energy Outlook 2006, December 2005, full report, February 2006

International Energy Outlook 2005, July 2005

Examples of Special Analyses

Analysis of Oil and Gas Production in the Arctic National Wildlife Refuge, March 2004

The Global Liquefied Natural Gas Market: Status and Outlook, Dec 2003

"Restricted Natural Gas Supply Case," *Annual Energy Outlook 2005*

www.eia.doe.gov

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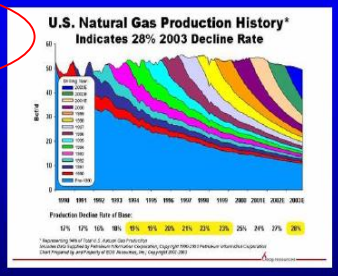
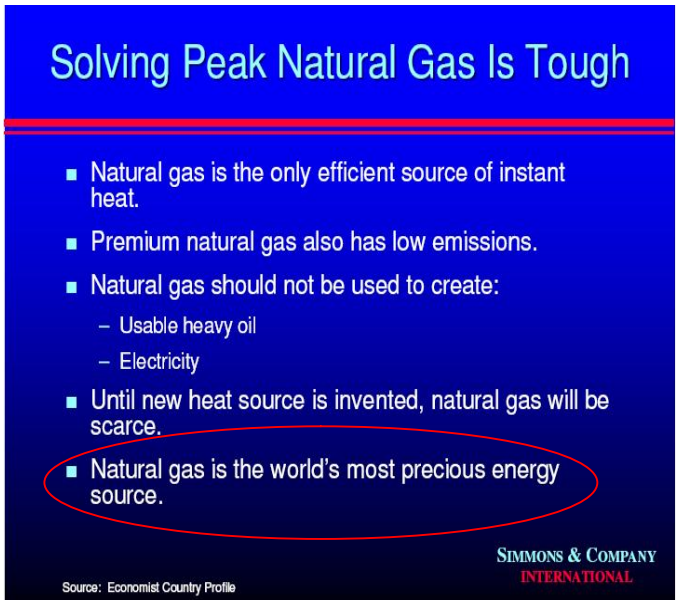
Solving Peak Natural Gas Problems Not Simple

- Peak natural gas is more serious than Peak oil.
- Natural gas is the world's only efficient creator of heat.
- It is improperly used to create electricity.
- Electricity is improperly used to create heat.
- Natural gas to liquids (GTL) and LNG are too energy intensive.
- No easy solutions are "at hand."

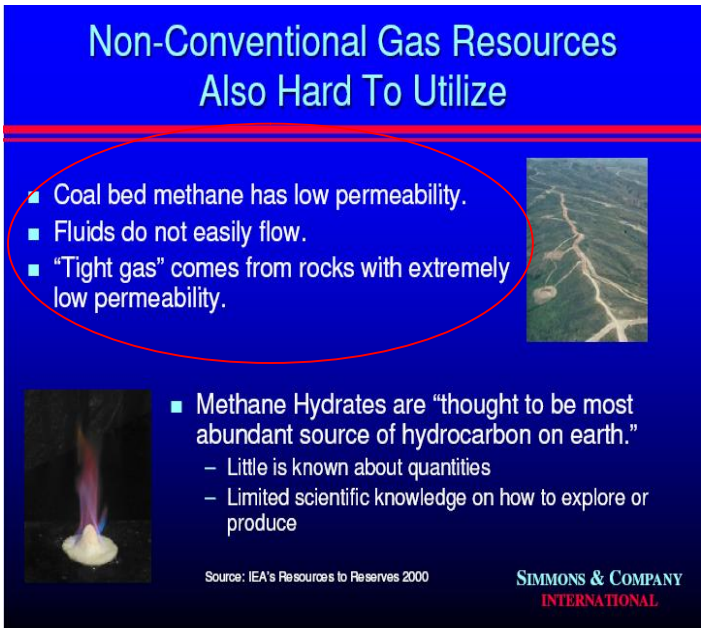


SIMMONS & COMPANY INTERNATIONAL

Matt Simmons. Peak Oil and Energy Politics. Februrary 8, 2006.
http://www.simmonsco-intl.com/files/John%20F.%20Kennedy%20School.pdf



Simmons, Matt. February 21, 2006. Lecture to Kansas City Chamber of Commerce http://www.simmonsco-intl.com/files/Kansas%20City%20Chamber%20of%20Commerce.pdf



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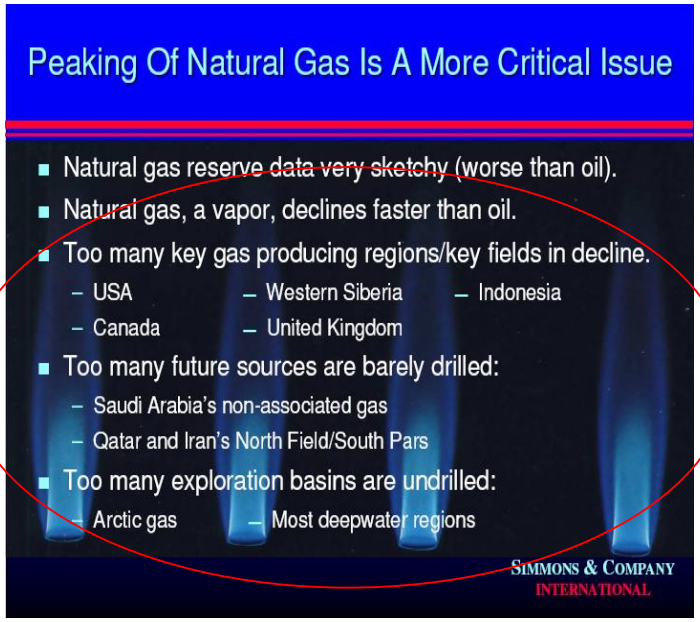

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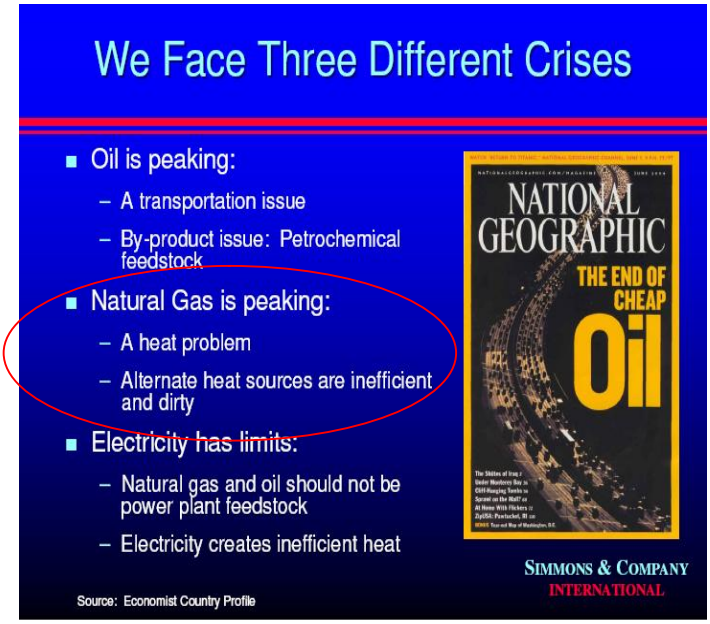

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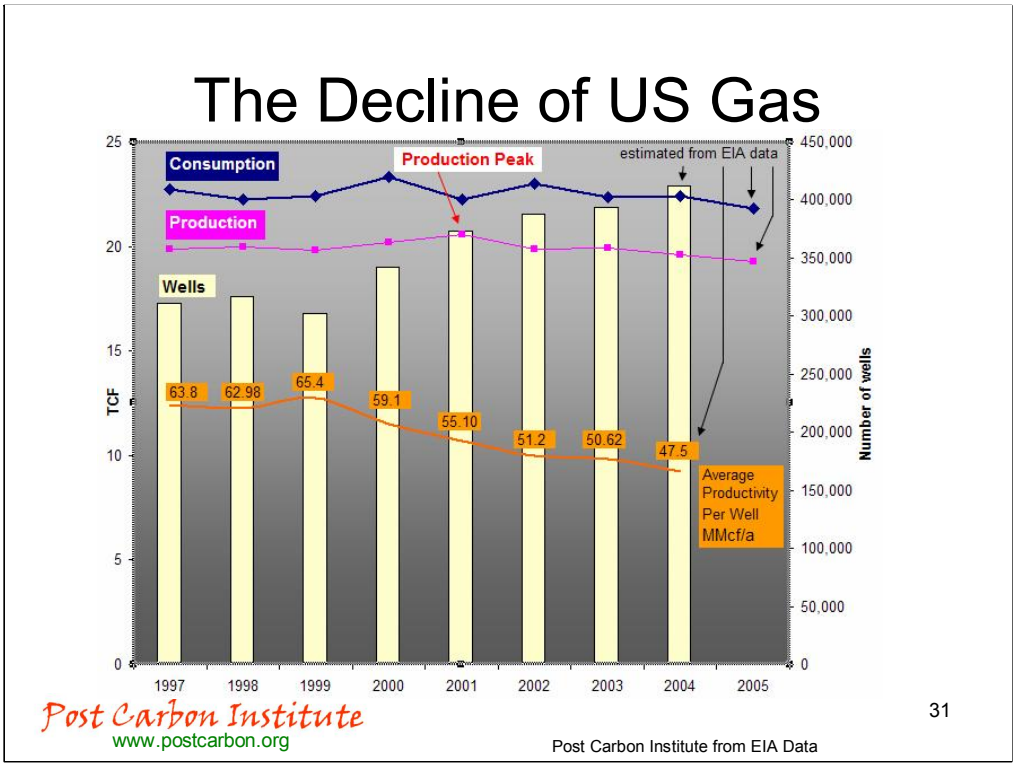
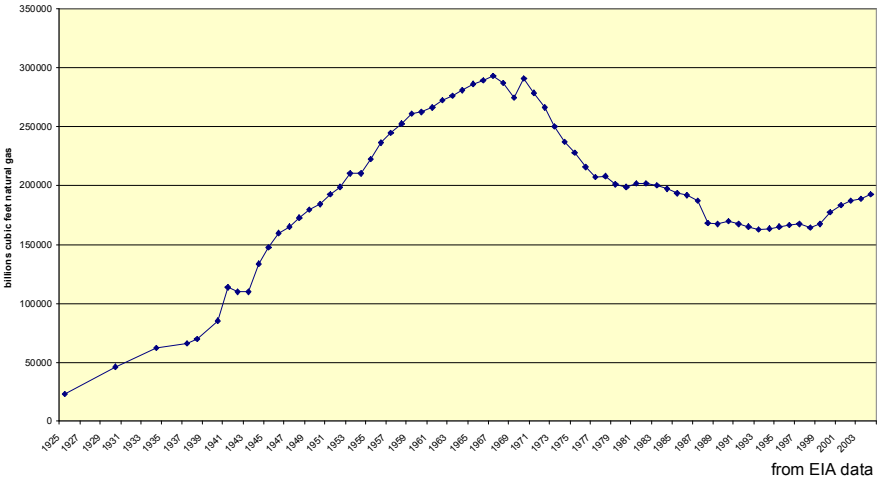


Well data from Number of Producing Gas and Gas Condensate Wells at http://tonto.eia.doe.gov/dnav/ng/ng_prod_wells_s1_a.htm

US Proven Gas Reserves



from EIA data

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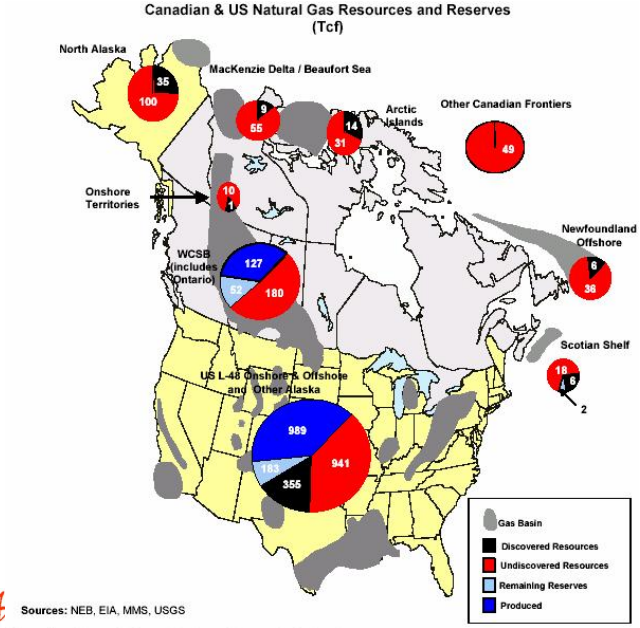
NA Gas Reserves



Sources: NEB, EIA, MMS, USGS

Canadian Natural Gas: Review of 2002 & Outlook to 2015

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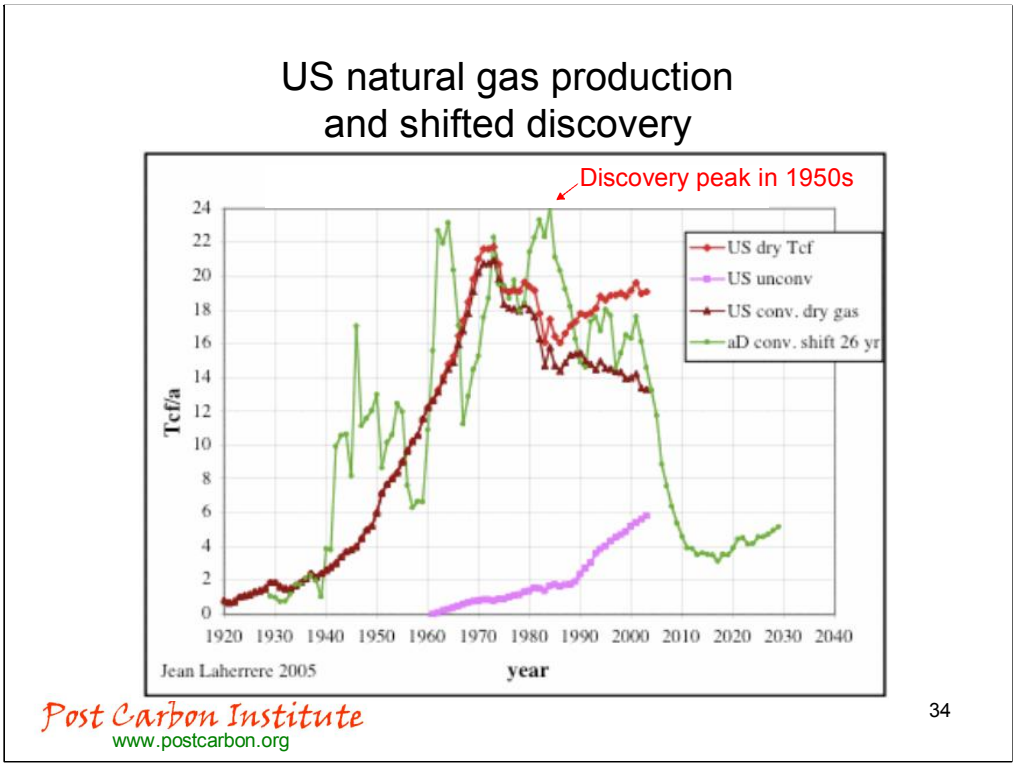


-**Forecasting production from past discovery by shifting to best fit**

In mature countries where there was little constraint on the demand production mimics discovery

(mean values) with a certain shift and this shift provides a useful way of forecasting.

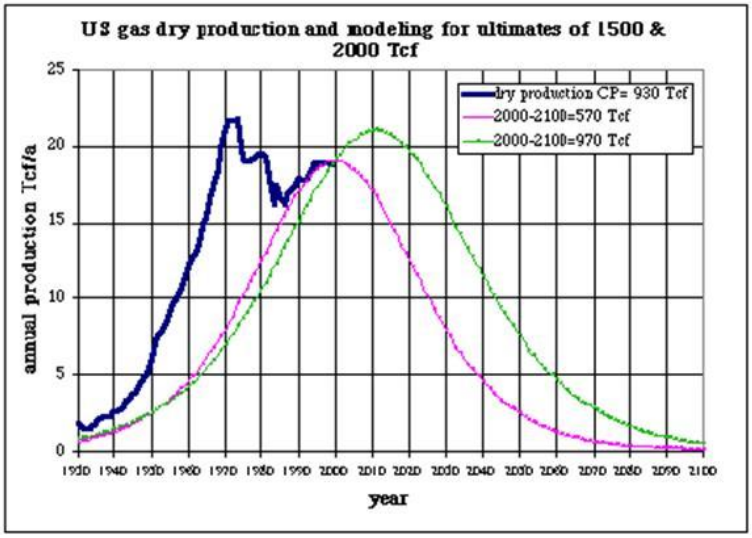
The shift of 26 years between US conventional natural gas production and discovery suggests a sharp

drop in future production as unconventional gas is forecasted to peak in few years by USDOE

Figure 11: US conventional natural gas annual production and shifted discovery forecasting a drastic

decline

US gas dry production & modeling



Jean Laherrere
Energy Exploration & Exploitation
Vol 20 2002, Numbers 2 & 3 35

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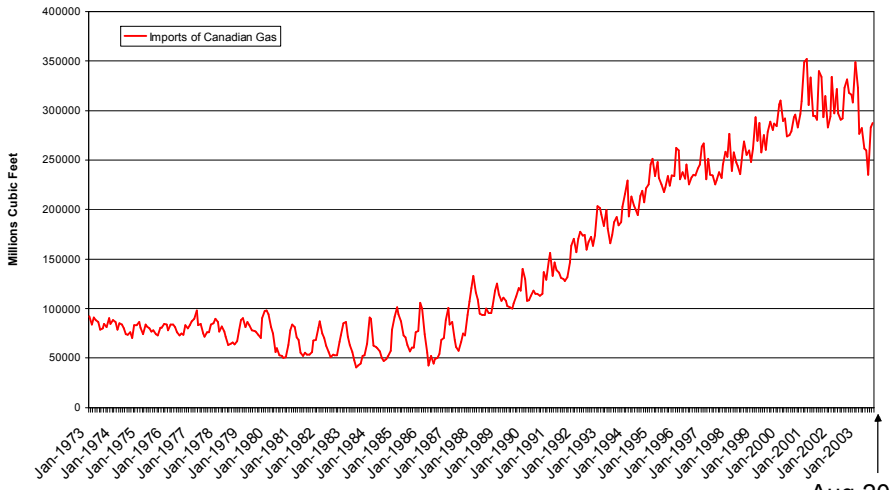
US Gas Imports from Canada

MMcf per month



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Post Carbon Institute from EIA data

Canadian Gas Production

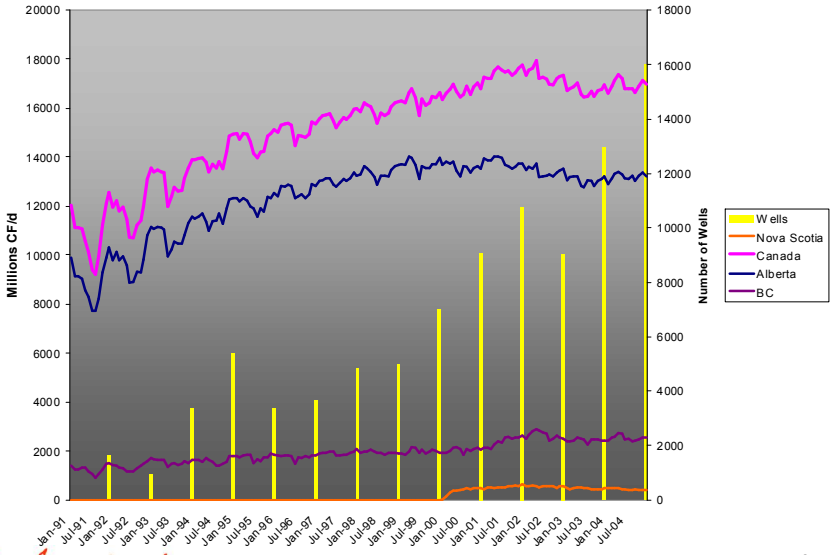

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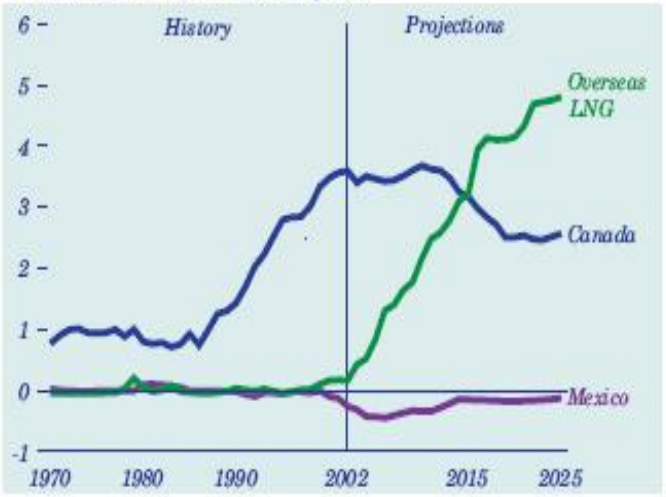
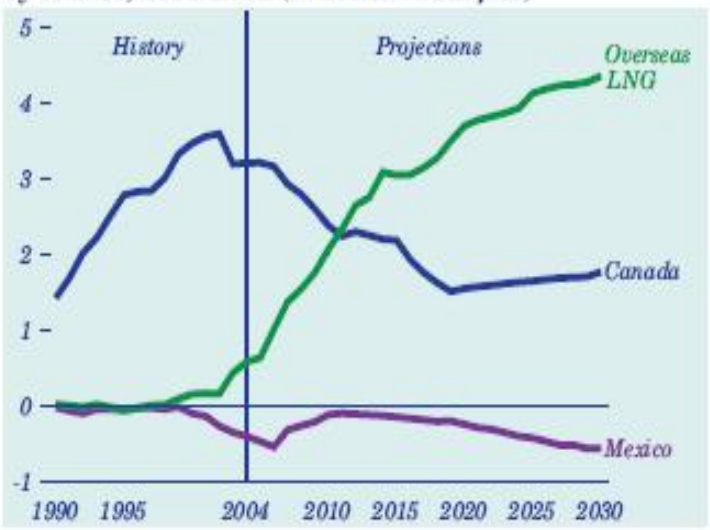
Figure 89. Net U.S. imports of natural gas, 1970-2025 (trillion cubic feet)



Energy Information Administration Annual Energy Outlook 2004, p. 91

Figure 74. Net U.S. imports of natural gas by source, 1990-2030 (trillion cubic feet)



Energy Information Administration Annual Energy Outlook 2006, p. 86

LNG Tankers

http://www.hydrocarbons-technology.com/projects/raslaffanref/images/img3.jpg

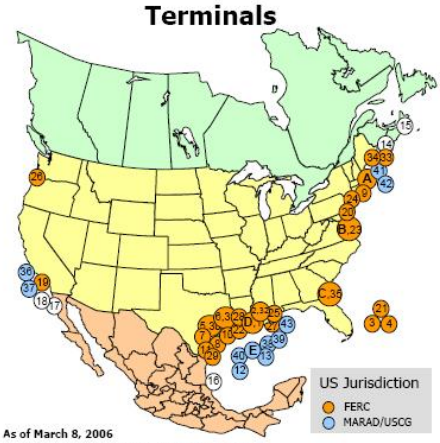
http://www.qatargas.com.qa/corporate-profile/images/history-10.jpg

Existing LNG Terminals

http://www.ferc.gov/industries/lng/indus-act/terminals/exist-term.asp

FERC

Existing and Proposed North American LNG Terminals



As of March 8, 2006

* US pipeline approved; LNG terminal pending in Bahamas

Office of Energy Projects

CONSTRUCTED
A. Everett, MA : 1.035 Bcfd (SUEZ/Tractebel - DOMAC)
B. Cove Point, MD : 1.0 Bcfd (Dominion - Cove Point LNG)
C. Elba Island, GA : 1.2 Bcfd (El Paso - Southern LNG)
D. Lake Charles, LA : 1.5 Bcfd (Southern Union - Trunkline LNG)
E. Gulf of Mexico: 0.5 Bcfd (Gulf Gateway Energy Bridge - Excelerate Energy)

APPROVED BY FERC
1. Lake Charles, LA: 0.6 Bcfd (Southern Union - Trunkline LNG)
2. Hackberry, LA : 1.5 Bcfd (Cameron LNG - Sempra Energy)
3. Bahamas : 0.84 Bcfd (AES Ocean Express)*
4. Bahamas : 0.83 Bcfd (Calypso Tractebel)*
5. Freeport, TX : 1.5 Bcfd (Cheniere/Freeport LNG Dev.)
6. Sabine, LA : 2.6 Bcfd (Cheniere LNG)
7. Corpus Christi, TX: 2.6 Bcfd (Cheniere LNG)
8. Corpus Christi, TX : 1.0 Bcfd (Vista Del Sol - ExxonMobil)
9. Fall River, MA : 0.8 Bcfd (Weaver's Cove Energy/Hess LNG)
10. Sabine, TX : 1.0 Bcfd (Golden Pass - ExxonMobil)
11. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)

APPROVED BY MARAD/COAST GUARD
12. Port Pelican: 1.6 Bcfd (Chevron Texaco)
13. Louisiana Offshore : 1.0 Bcfd (Gulf Landing - Shell)

CANADIAN APPROVED TERMINALS
14. St. John, NB : 1.0 Bcfd (Canaport - Irving Oil)
15. Point Tupper, NS 1.0 Bcf/d (Bear Head LNG - Anadarko)

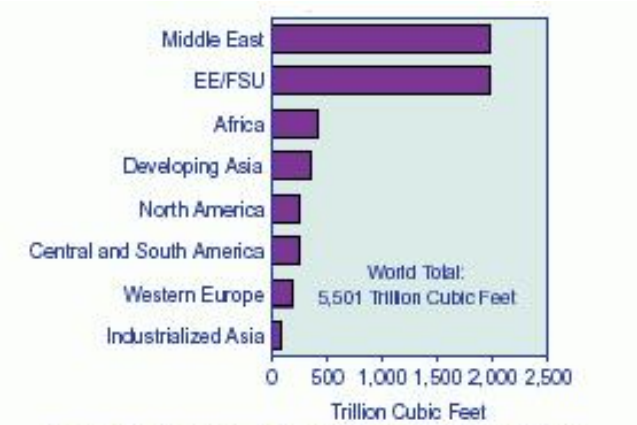
MEXICAN APPROVED TERMINALS
16. Altamira, Tamulipas : 0.7 Bcfd, (Shell/Total/Mitsui)
17. Baja California, MX : 1.0 Bcfd, (Energy Costa Azul - Sempra)
18. Baja California - Offshore : 1.4 Bcfd, (Chevron Texaco)

PROPOSED TO FERC
19. Long Beach, CA : 0.7 Bcfd, (Mitzubishi/ConocoPhillips - Sound Energy Solutions
20. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG - BP)
21. Bahamas : 0.5 Bcfd, (Seafarer - El Paso/FPL)
22. Port Arthur, TX: 1.5 Bcfd (Sempra)
23. Cove Point, MD : 0.8 Bcfd (Dominion)
24. LI Sound, NY: 1.0 Bcfd (Broadwater Energy - TransCanada/Shell)
25. Pascagoula, MS: 1.0 Bcfd (Gulf LNG Energy LLC)
26. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
27. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - ChevronTexaco)
28. Cameron, LA: 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
29. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
30. Freeport, TX: 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)
31. Sabine, LA: 1.4 Bcfd (Cheniere LNG - Expansion)
32. Hackberry, LA : 1.15 Bcfd (Cameron LNG - Sempra Energy - Expansion)
33. Pleasant Point, ME : 0.5 Bcfd (Quoddy Bay, LLC)
34. Robbinston, ME: 0.5 Bcfd (Downeast LNG - Kestrel Energy)
35. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG)

PROPOSED TO MARAD/COAST GUARD
36. California Offshore: 1.5 Bcfd (Cabrillo Port - BHP Billiton)
37. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
38. Louisiana Offshore : 1.0 Bcfd (Main Pass McMoRan Exp.)
39. Gulf of Mexico: 1.0 Bcfd (Compass Port - ConocoPhillips)
40. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
41. Offshore Boston, MA: 0.4 Bcfd (Neptune LNG - Tractebel)
42. Offshore Boston, MA: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)
43. Gulf of Mexico: 1.4 Bcfd (Bienville Offshore Energy Terminal - TORP Technology)

http://www.ferc.gov/industries/lng/indus-act/terminals/exist-prop-lng.pdf

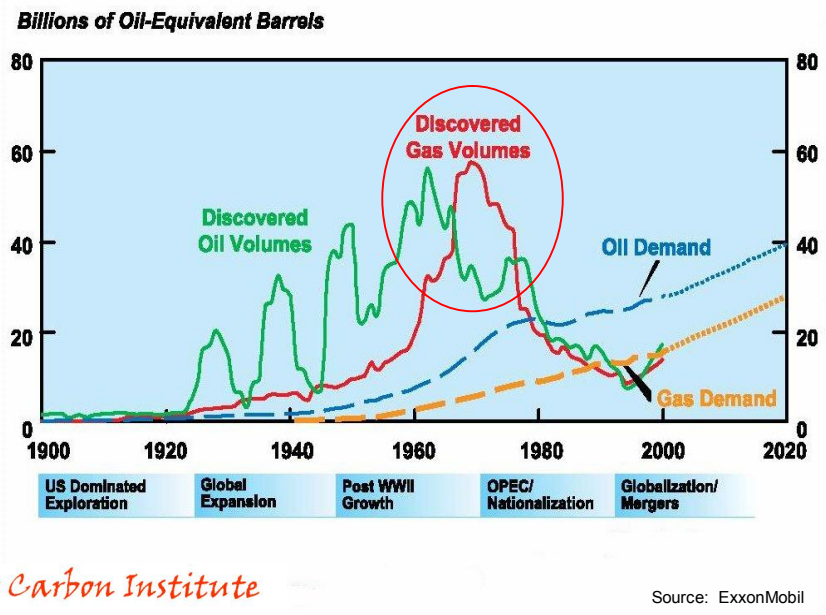
World Natural Gas Reserves
by Region (as of Jan 1, 2003)



Source: "Worldwide Look at Reserves and Production," *Oil & Gas Journal*, Vol. 100, No. 52 (December 23, 2002), pp. 114- 115.

ftp://ftp.eia.doe.gov/pub/pdf/international/0484(2003).pdf

Exxon-Mobil: discovery has peaked

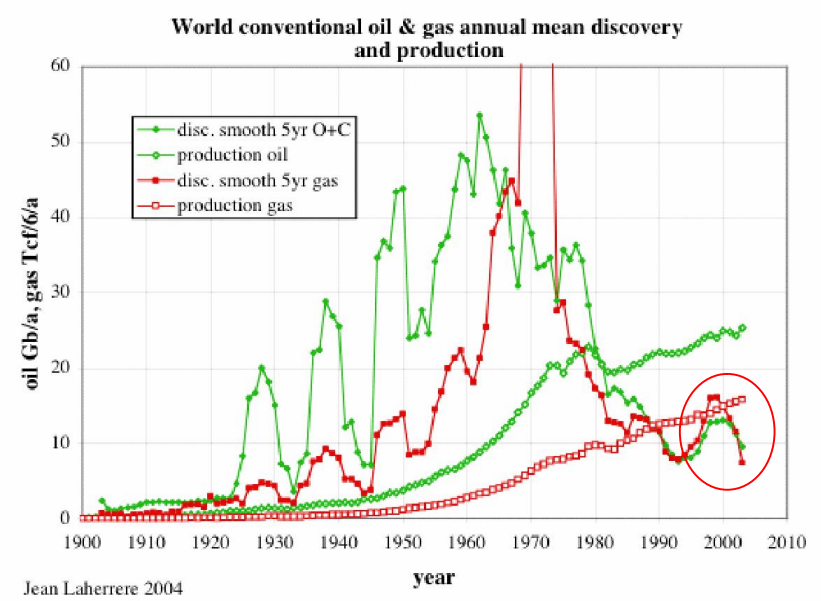


Post Carbon Institute

www.postcarbon.org

Source: ExxonMobil

Oil & Gas Discovery: Endgame



Jean Laherrere 2004

www.postcarbon.org

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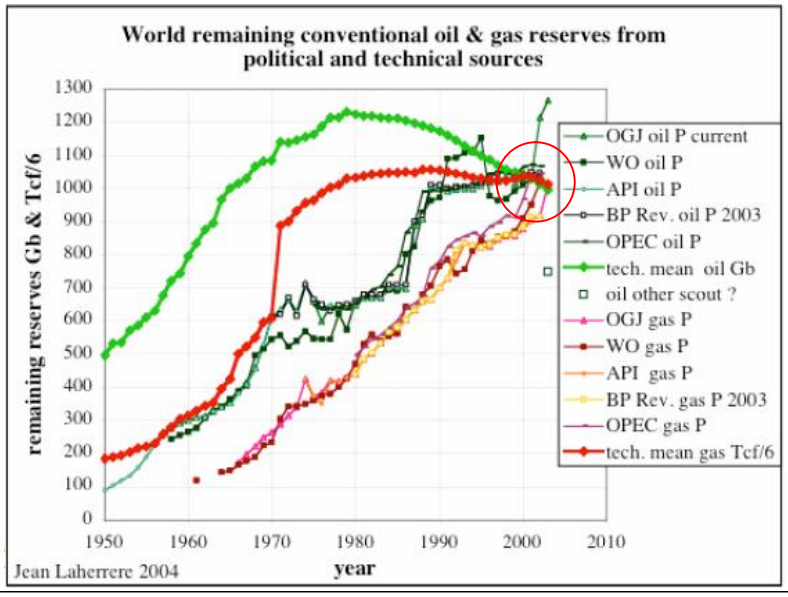
World remaining conventional oil & gas reserves



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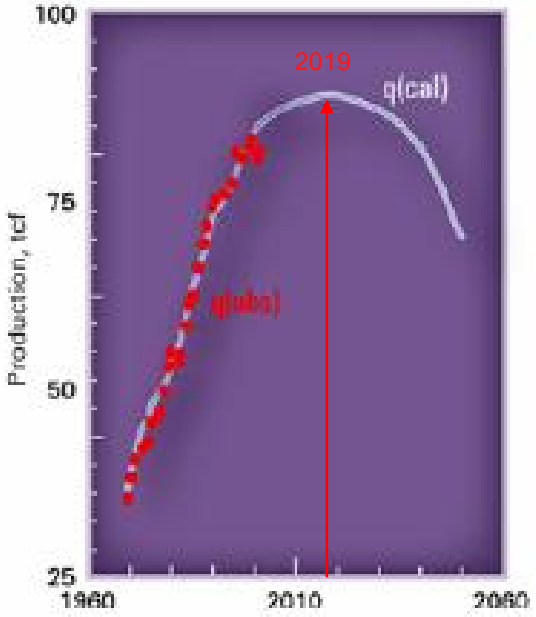
World Gas Production Peak?

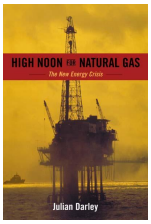


Conventional gas forecast from The Oil & Gas Journal Aug 2004

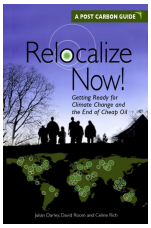
Faith or Wisdom?

- DOE: don't worry – we've got our eye on the situation – please keep consuming
- If the energy realists are right, then we shall have to reduce demand
- Planned energy reduction is wiser than unplanned reduction
- It will make producing the substitutes in sufficient quantity much more likely
- And give us a better chance of a long term future

For interviews about oil & gas peak
www.globalpublicmedia.com



High Noon for Natural Gas
The New Energy Crisis
by Julian Darley
Available from store.postcarbon.org



Relocalize Now! Preparing for Climate Change & the End of Cheap Oil
by Julian Darley, David Room, Celine Rich & Richard Heinberg
Spring 2006 from New Society Publishers

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